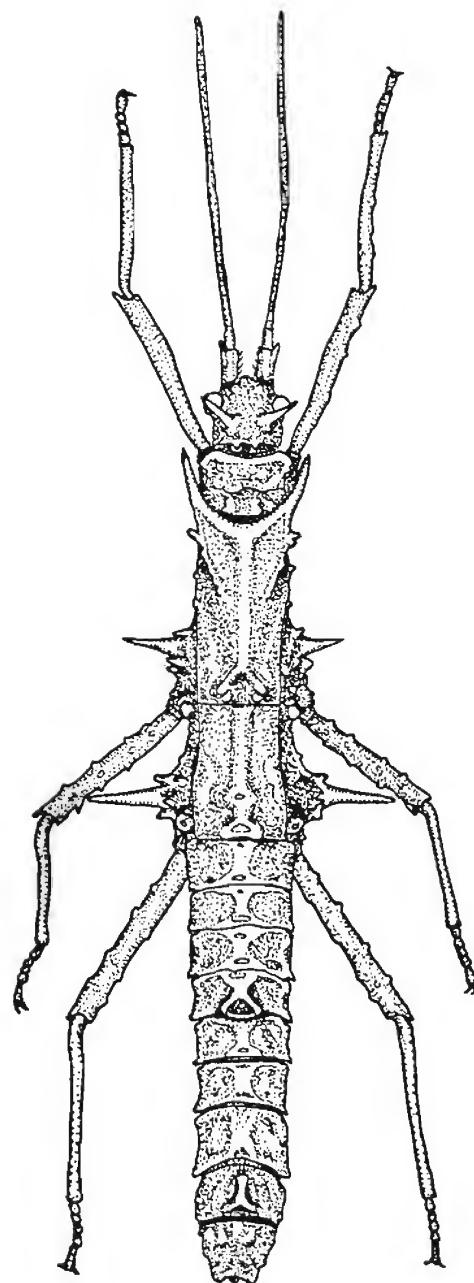


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Studies of the genus *Phalces* Stål

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Abstract

Phalces tuberculatus sp.n. is described from Eland's Bay, Cape Province, South Africa. A key is given to distinguish the *Phalces* species. Brief notes are given on behaviour, foodplants, and culture notes in the case of *P. longiscaphus* (de Haan).

Key words: Phasmida, *Phalces*, *Phalces tuberculatus* sp.n.

Introduction

As part of my studies on South African stick-insects, I visited Cape Town in September 1998. My research included an examination of the entomology collection at the South African Museum in Cape Town, in addition to material of *Phalces* species in various museums, observing *P. longiscaphus* in the wild and rearing this species in captivity. The observations include the description of *Phalces tuberculatus* sp.n. and a key to distinguish the three *Phalces* species (of which a Madagascan insect is unlikely to belong to this genus). Museum codens are given below:

| | |
|------|---|
| BMNH | Natural History Museum, London, U.K. |
| NHMW | Naturhistorisches Museum, Wien, Austria. |
| RMNH | Nationaal Natuurhistorisch Museum, Leiden, Netherlands. |
| SAMC | South African Museum, Cape Town, South Africa. |

***Phalces* Stål, 1875**

Phalces Stål, 1875: 62, 102.

Characteristics of the genus

Body elongate, unarmed, smooth or granulated. Third antennal segment three times longer than second segment. In both sexes, fore femora unarmed; except for short pair of apical spines. Mid and hind femora in female with 1-2 pairs of subapical spines, sometimes a further 1 or 2 smaller spines; in male ranging from no spines to 2 pairs, usually smaller than in female. Pair of short apical spines present on all femora. Operculum in female with long chute-like extension. Cerci short, variable.

Key to males

1. Body with black median line. Only hind femora with 1-2 subapical spines. *P. unilineatus*
- Body all one colour, or with variegated blotches; lacking black median line. Mid and hind femora with 1 to 4 pairs of small black subapical spines (occasionally absent or very short) 2
2. Body smooth. Body length 50-55mm. *P. longiscaphus*
- Body with numerous tubercles/granulations, particularly on thorax. Body length 52-61.5mm. *P. tuberculatus* sp.n.

Key to females

(Note - colour forms may vary in each species - *P. unilineatus* unknown)

1. Body smooth. Body length 70-80mm. *P. longiscaphus*
- Body with numerous tubercles/granulations, particularly on thorax. Body length 86-93mm. *P. tuberculatus*

***Phalces longiscaphus* (de Haan). (Figures 1 & 2)**

Phasma (Bacillus) longiscaphum de Haan, 1842: 101. Syntype series: 2 females, Cape of Good Hope [Prom. bon. spei], leg. Horstok [RMNH, Leiden] [examined].
Bacillus longiscaphum (de Haan); Westwood, 1859: 5.
Phalces longiscaphum (de Haan); Kirby, 1904: 336.
Phalces longiscaphus (de Haan); Redtenbacher, 1906: 28, pl. 2.1; Le Feuvre, 1936: 80, (incl. figures/plates of both sexes, nymphs and eggs); Brock, 1999: [in press].
Bacillus coccyc Westwood, 1859: 6, pl. 7.5. Syntype series: 2 females, "Africa australis" [BMNH, London] [examined] (synonymised by Kirby, 1904: 336).
Phalces coccyc (Westwood); Stål, 1875: 102.

Description

Male 50-55mm, female 70-80mm. Very stick-like, medium-sized, wingless insects with short antennae. The male is greenish brown with three bluish green marks and white bands on each of the pronotum, hind part of the mesonotum and metanotum. The legs are green, with a brown base and apical band on all femora; plain or slightly mottled in female. Females are usually brown or grey, perhaps speckled; occasionally green.

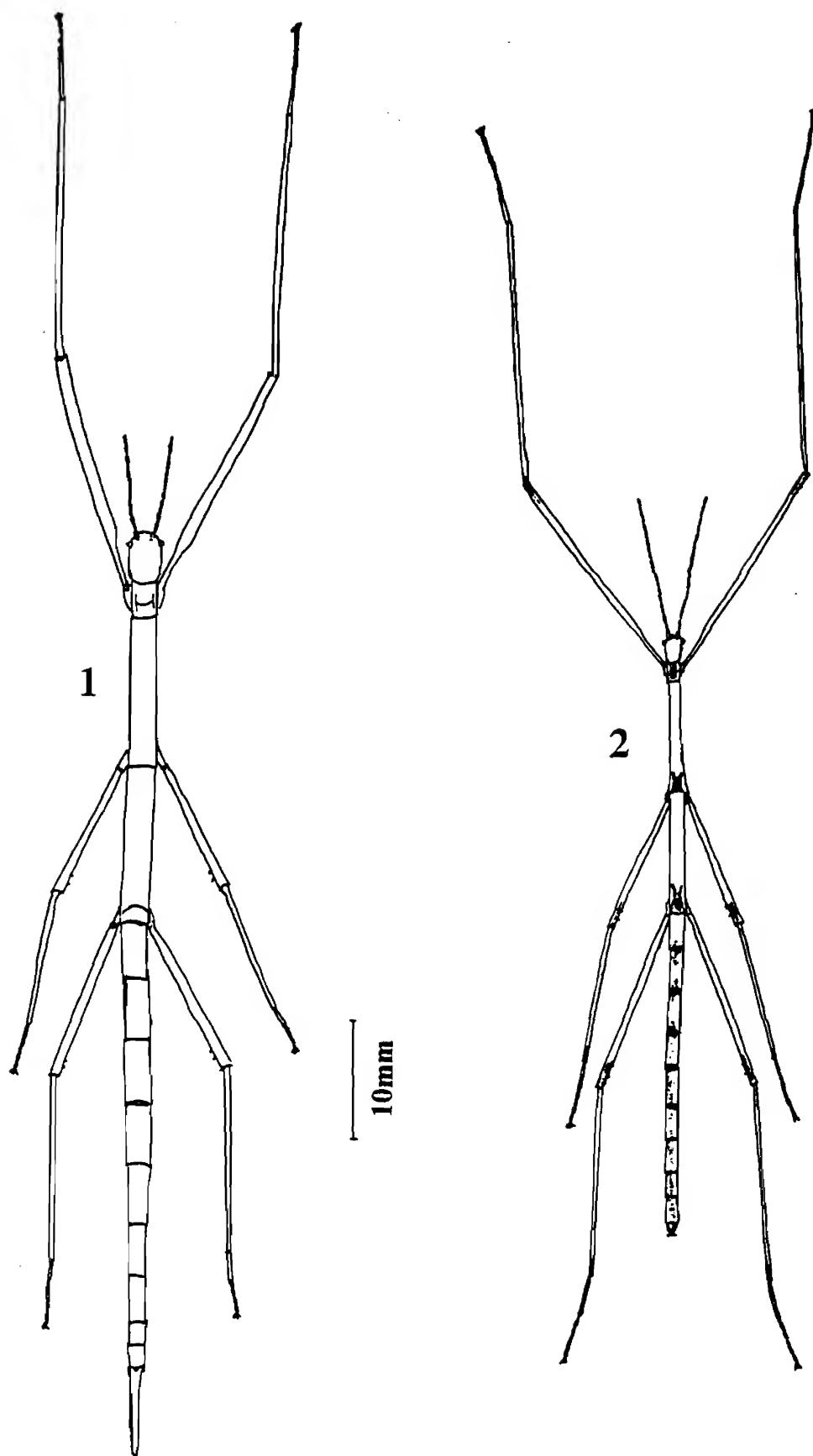
Head.- Longer than wide, eyes small, brown. Antennae short, 22 segments in male, 19 segments in female; basal segment rather broad, remainder of segments narrower. Second segment very short, broader than long. Third segment almost as long as basal segment. Other segments short except tip, which is as long, but narrower than 3rd segment.

Thorax.- Thorax smooth in both sexes. Pronotum a little shorter than head; central indentation present. Mesonotum 4 to just over 4 times length of pronotum. Metanotum about same length as mesonotum; first abdominal segment short.

Abdomen.- Long and slender. In male anal segment same length as 9th segment, tip subtruncate. Subgenital plate broad, slightly rounded at tip, which does not reach end of 9th segment. Cerci short, narrow, club shaped at tip (colour: white in nature, may be brown on dead specimens). In female, end of anal segment subtruncate; rounded supraanal plate visible beneath. The abdomen ends in a boat-shaped chute-like appendage, which varies considerably in length (Favrelle, 1938 illustrates such variation). Usually, the appendage is about 4 times the length of the anal segment, [i.e. extends beyond anal segment by about twice the length of that segment] but may be much longer, or occasionally shorter. Cerci short, narrow; slightly rounded at tip.

Legs.- Long, unarmed except mid and hind femora, which have 2-4 pairs of small black-tipped subapical spines (of which 2 pairs are smaller than others. Occasionally males have either very short spines, or they are absent). All femora with a pair of short apical spines. Tibiae slightly broadened at base. Legs slightly hairy.

Habits: This species mainly relies on its effective camouflage for protection. They hide in the daytime and are rarely seen, until evening when they return to food-plants. When disturbed, nymphs sway from side to side. Adults mate frequently producing a spermatophore (sperm sac). Compton & Ware (1991) reported that ants carry eggs of this species to their nests, using the capitulum (knob on the lid of the egg) in a similar way as elaisomes on seeds. The capitulum is removed and eaten without reducing egg viability. Le Feuvre (1936) had clearly observed this behaviour when commenting "...the ant begins its attacks even before hatching takes place by carrying off the eggs to its nest". However, he associated this behaviour with an attack, speculating that "At a later stage it pulls the newly-hatched insects to pieces to facilitate removal of its larder". In a later paper, Le Feuvre (1939) adds that ants are attracted to the spermatophore in mating pairs of this species; they



Figures 1-2. *Phalces longiscaphus*: 1) female, 2) male.

remove the small whitish-green sperical objects to take back to the nest. Whilst rearing *longiscaphus*, he also observed that a female introduced to the cage was savagely attacked by another female, resulting in part of a leg being bitten off.

Culture Notes: This species was reared in France in the mid 1930's (Favrelle, 1938), where it was considered to be able to breed parthenogenetically, as well as bisexually; and in the UK in 1968. This species is fairly straightforward to rear in partly ventilated cages at a temperature of about 21°C: eggs hatch in about 4-6 months. Le Feuvre (1936) reported that it takes nymphs 6 months to mature, after 5 moults, with nymphs often losing legs. Eggs are dropped to the ground by females; they are very glossy, dark brown with a lighter, but small capitulum; eggs are easily damaged and need to be handled carefully. A few eggs are laid each day and Le Feuvre noticed a bluish-grey membrane wrapped around some eggs, although I did not observe this. The females I found at Constantia Nek commenced egg-laying in mid-September, about 3 weeks after maturing and died by the end of December 1998. One male survived until June 1999, indicating that females may live longer in the wild than they survived in captivity. Eggs hatched from February-April 1999. The abdomens of fresh adult females are very thin, but fatten up prior to egg-laying.

Food-plants: As reported in Brock (1999) i.e. *Leptospermum laevigatum* (Myrtaceae), *Erica aemula* (Ericaceae), *Rhus* spp. (Anacardiaceae), *Passerina* spp. (Thymelaeaceae), *Rubus fruticosus* (Rosaceae), *Liparia splendens* (Leguminosae). [Le Feuvre, 1936, who also mentioned the "Yellow-wood tree" [likely to be a *Podocarpus* species, probably *P. latifolius*], although it was not clear if it was in connection with this species or *Macynia labiata* (Thunberg)]. In captivity feeds well on *Erica* spp. (Ericaceae), *Rubus fruticosus* (Rosaceae) and *Leptospermum scoparium* (Myrtaceae). Favrelle (1938) also refers to *Rosa* spp. (Rosaceae), *Quercus* spp. (Fagaceae) and *Tradescantia* (Commelinaceae).

Distribution: [PB = P. Brock, HR = H. Robertson]. All localities in Cape Province, South Africa, as follows: Harold Porter Botanical Gardens, Betty's Bay, 9.ix.1998 (1st and 2nd instar nymphs, 12mm & 20mm respectively) (PB); Bloukrans River, 20 miles ENE Plettenbergbaai (Günther, 1956); Cape Suburbs (Le Feuvre, 1936); Cape Town (BMNH); Cape of Good Hope Nature Reserve (PB); Cape Peninsular, leg. Lightfoot, vi.1913 (SAMC); Table Mountain, Blinkwater (Günther, 1956); Cedarberg (SAMC); Claremont (Günther, 1956); Constantia Nek, 8-14.ix.1998 (PB); Hout Bay (Günther, 1956); Kirstenbosch Botanical Gardens (Le Feuvre, 1936); Grahamstown (Compton & Ware, 1991); Kleinmond, 9-21.ii.1993 (HR); Langebaan (Günther, 1956); Maanschijnkop, 7 miles E Hermanus (Günther, 1956); Stellenbosch (BMNH); Swartbergpas, Platberg (Günther, 1956). Redtenbacher (1906) also lists "Ostafrika (Westwood), Grusien, Azkur coll. m." (coll. m = Brunner's collection in Wien) and Günther (1956) lists Royal Natal National Park, Tugela Valley, Natal. PB's records are all adults or last instar nymphs, except where stated (note - all type and non-type material in museum collections has been examined).

Etymology: The species name means long boat-shaped; referring to the "chute" (operculum) at the end of the female's abdomen.

***Phalces tuberculatus* sp.n. (Figures 3-7)**

Holotype ♂, South Africa: Leipoldville, Eland's Bay, C[ape] P[rovince], Mus[eum] Exp[edition], x.1947 (SAMC). Paratype series: ♂, 2♀♀, South Africa: Leipoldville, Eland's Bay, C[ape] P[rovince], Mus[eum] Exp[edition], xi.1948; also ♀ nymph, same data as holotype (SAMC).

Description of male

Holotype male. A long, slender insect, with tubercles on head, thorax and abdomen. Uniform dark brown, with whitish dusting on thorax and abdomen.

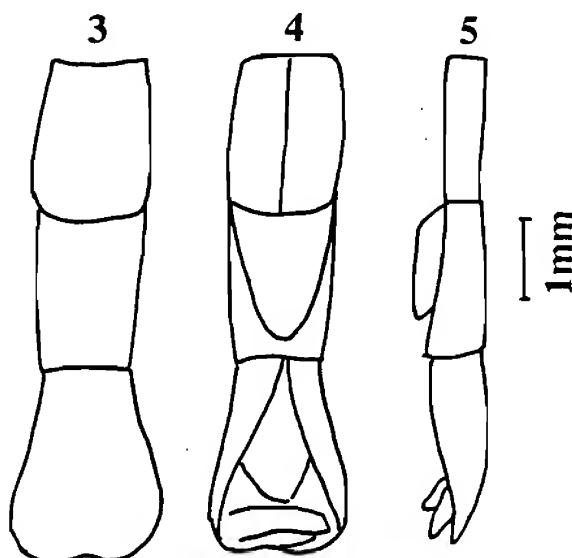
Head. - Longer than wide, slightly granulated near central carina; eyes small, brown with blackish flecks. Antennae short, 14 segments; basal segment very broad and elongate, remainder of segments narrower. Second segment very short, broader than long. Third segment almost as long as basal segment. Other segments short except tip, which is as long, but narrower than 3rd segment. The last few segments darker.

Thorax. - Pronotum a little shorter than head, with a number of small granulations or tubercles. Central indentation present. Mesonotum just over 4 times length of pronotum; with numerous small dark round tubercles, some around central area, including a few larger well spaced ones; hind part with smaller tubercles. Metanotum marginally longer than mesonotum, with a number of tubercles, mainly small. The tubercles extend to ventral surface of thorax.

Abdomen. - Long and slender; some granulations, 8th segment broadened towards tip. Anal segment same length as 9th segment, but broadened towards tip, which is bulbous and almost rounded. Subgenital plate broad and swollen, slightly rounded at tip, which does not reach end of 9th segment. Cerci stout, slightly rounded at tip; hidden beneath anal segment.

Legs. - Long, unarmed except mid and hind femora, which have 2 pairs of small black-tipped subapical spines (although all femora have short pair of apical spines). Tibiae slightly broadened at base. Legs slightly hairy. (note - right fore leg missing).

Paratype male same as holotype, but only 52mm. Also, hind part of metanotum with whitish marks, similar to those in *P. longiscaphus*.



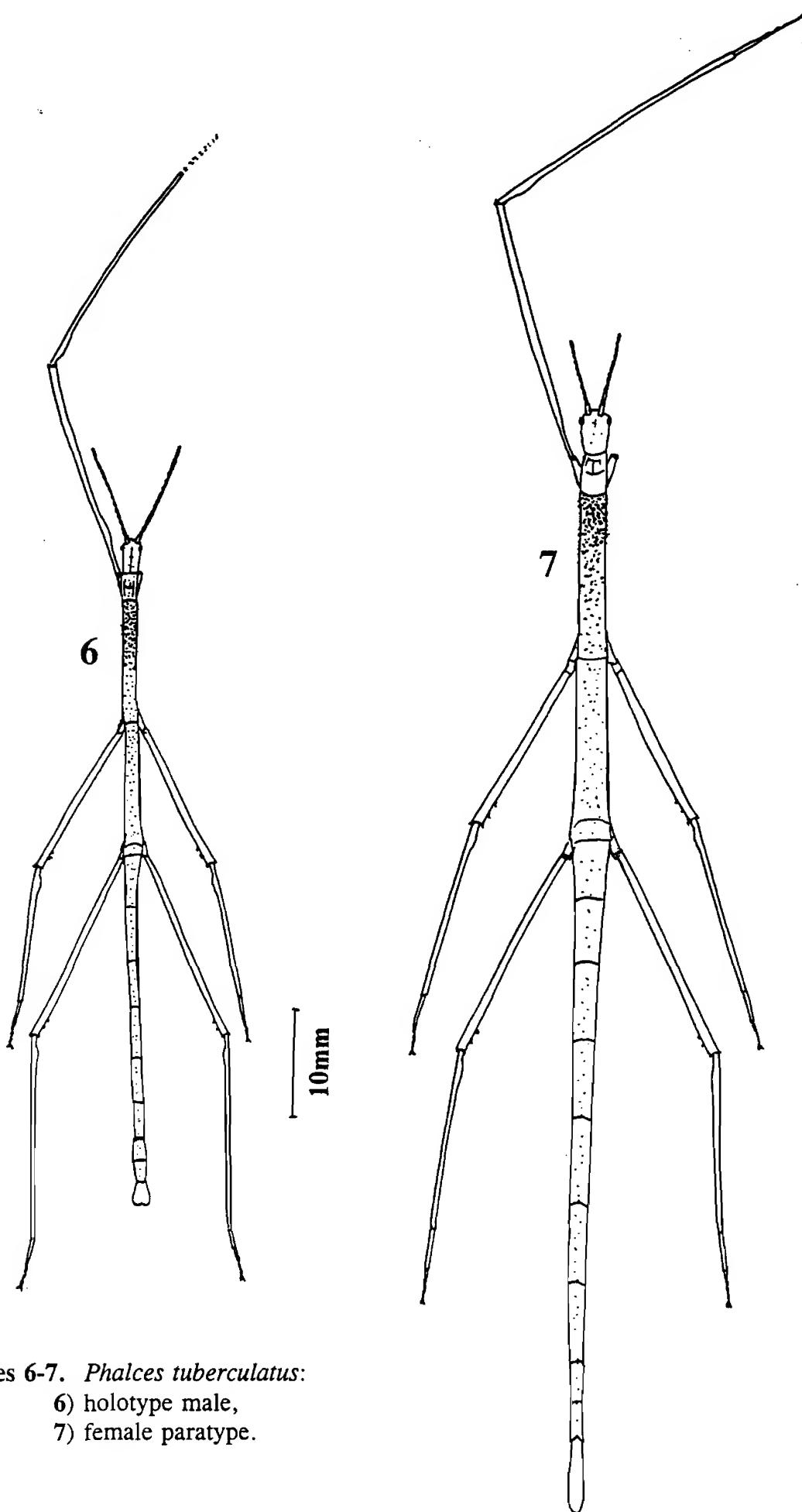
Figures 3-5.

Phalces tuberculatus, end of male's abdomen: 3) dorsal, 4) ventral, 5) lateral.

Description of Female

Length 86-93mm. Paratype females rather broader than male, dark brown, elongate insects with similar range of tubercles.

Head. - Longer than wide, slightly granulated near central carina; eyes small. Antennae short, 13 segments; basal segment very broad and elongate, remainder of segments narrower. Second segment very short, broader than long. Third segment almost as long as basal segment. Other segments short except tip, which is as long, but narrower than 3rd segment.



Figures 6-7. *Phalces tuberculatus*:

- 6) holotype male,
- 7) female paratype.

Thorax. - Pronotum a little shorter than head, with a number of small granulations or tubercles. Central indentation present. Front of segment with inverted "v" shaped indentation. Mesonotum just over 4 times length of pronotum; with numerous tubercles, some around central area. In one specimen 3 larger, uneven pairs of well spaced tubercles are present; hind part with smaller tubercles. Metanotum with mainly small tubercles; segment marginally longer than mesonotum. The tubercles extend to ventral surface of thorax.

Abdomen. - Long and slender, narrowing towards tip; some granulations present. Ninth and 10th segments shorter than previous segments. Anal segment longer than wide; with central circular incision leaving a two pronged structure. Anal segment longer than wide; almost 3mm long. Operculum long chute-like extension; spatulate, broadened towards tip, which is almost rounded. Operculum exceeds end of anal segment by about 1.5 times length of that segment. Cerci short, hidden beneath anal segment.

Legs. - Long, unarmed except mid and hind femora, which have 2 pairs of small black subapical spines (although all femora have pair of short apical spines). Tibiae slightly broadened at base.

Measurements (mm)

| | Male holotype | Male paratype | Females |
|----------------|---------------|---------------|---------|
| Body length | 61.5 | 52 | 86-93 |
| Head | 3 | 2.2 | 4 |
| Antennae | 9.5 | 7 | 8 |
| Pronotum | 2.5 | 2 | 3.5 |
| Mesonotum | 11 | 9.5 | 14.5-15 |
| Metanotum | 11 | 10.5 | 13-14.5 |
| Median segment | 1 | 1 | 2 |
| Cerci | 1.5 | 1.2 | 0.5 |
| Fore Femora | 20 | missing | 21-24 |
| Mid Femora | 14 | 12 | 15 |
| Hind Femora | 18 | 16 | 19-20 |
| Fore Tibiae | 21 | missing | 22.5-25 |
| Hind Tibiae | 18 | 16.5 | 18-20 |

Distribution: Only known from Eland's Bay.

Etymology: Named *tuberculatus* in view of the numerous tubercles present on the body of this species.

Phalces unilineatus Redtenbacher (Figure 8)

Phalces unilineatus Redtenbacher, 1906: 28, pl. 3.2. Holotype ♂, Madagascar: central Meda, leg. Dr. H. Dohrn (NHMW, coll. no. 14) [examined].

This species is unlikely to belong to this genus because of the absence of spines on the mid femora (see key), hence a full description is not provided here. However, it is not appropriate to transfer it to another genus without the benefit of examining further material.

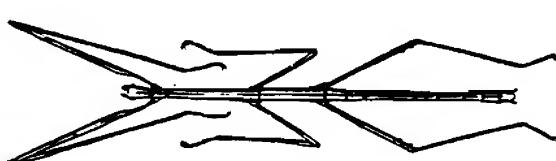


Figure 8.

Phalces unilineatus male (From Redtenbacher, 1906).

Acknowledgements

The author would like to thank curators of the various museums mentioned, particularly H.G. Robertson (SAMC) for access to the collection, organising a loan of material for detailed study, and for providing details of food-plants and other information he had recorded for *P. longiscaphus* in the Cape Town area.

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Redescription of *Mantis filiformes* Fabricius (Phasmatidae: Bacteriinae)

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Abstract

Mantis filiformes Fabricius, 1787 from South America is redescribed and illustrated. As a junior homonym of *Mantis filiformis* Herbst, 1786, the Fabrician species name has been replaced by *Bacteria fabricii* nom.nov.

Key words

Phasmida, *Mantis filiformes*, redescription, *Bacteria fabricii* nom.nov.

Introduction

Descriptions of some of the first stick insects in the late 1700s tended to be very brief. In some cases, researchers have never followed up on these species, or have even avoided reference to them. When discussing *Bacteria filiformis* (see later for notes on spelling variations), Westwood (1859) remarked "This is another insect of which the insufficiency of the early description renders identification nearly impossible." He goes on to describe how subsequent authors have become confused by this species. I made a start on the Fabrician type material by redescribing four species deposited in the Zoological Museum, University of Copenhagen collection (Brock, 1998a). As part of my research, I visited the Hunterian Museum, Glasgow, Scotland (HMUG) in 1997 to redescribe *Mantis filiformes* Fabricius for this paper. My objective is to clarify the early literature and assist in preventing workers on phasmids from publishing descriptions of new species which are subsequently linked to existing species. Some recent authors have relied heavily on the classification in Brunner and Redtenbacher (1906-08); although this is the most recent monograph on the Phasmida, it includes a number of deficiencies (Brock, 1998b).

***Bacteria fabricii* nom.nov. (Figure 1a-d)**

Mantis filiformes Fabricius, 1787: 227.

Mantis filiformis - Fabricius, 1793: 12. [justified emendation]

Phasma filiformis - Fabricius, 1798: 106.

Bacteria filiformis - Latreille et al., 1827: 157.

Selected references only are cited above.

Material examined

Holotype female, South America "America meridionali, Mus. D. Hunter" (HMUG).

Description

Female: 146mm mottled dark brown, elongate smooth bodied and wingless insects; legs rather lighter; slightly mottled.

Head. Longer than wide. Eyes small, dark brown. Hint of four dark lines to back of head. Antennae dark brown, almost black, indistinctly segmented; first segment larger. Antennae almost as long as fore legs.

Thorax. Pronotum shorter than head, with central cross-like indentation. Mesonotum almost 10 times length of pronotum. Metanotum much shorter than mesonotum; width 4mm.

Abdomen. First seven segments similar in length at around 10mm. Hind part of 6th segment raised dorsally; very slight hint of same on other segments. Hind part of underside of 7th segment with small stout central spine. The final three segments are much shorter than the preceding segments, with 8th segment 3.5mm long, 9th 3mm and anal segment (10th) 3.2mm. End of anal segment slightly rounded. Cerci short, stout, rounded at tip. Operculum long, boat shaped, exceeding end of anal segment; tip broad, rounded (Figures 1c-d).

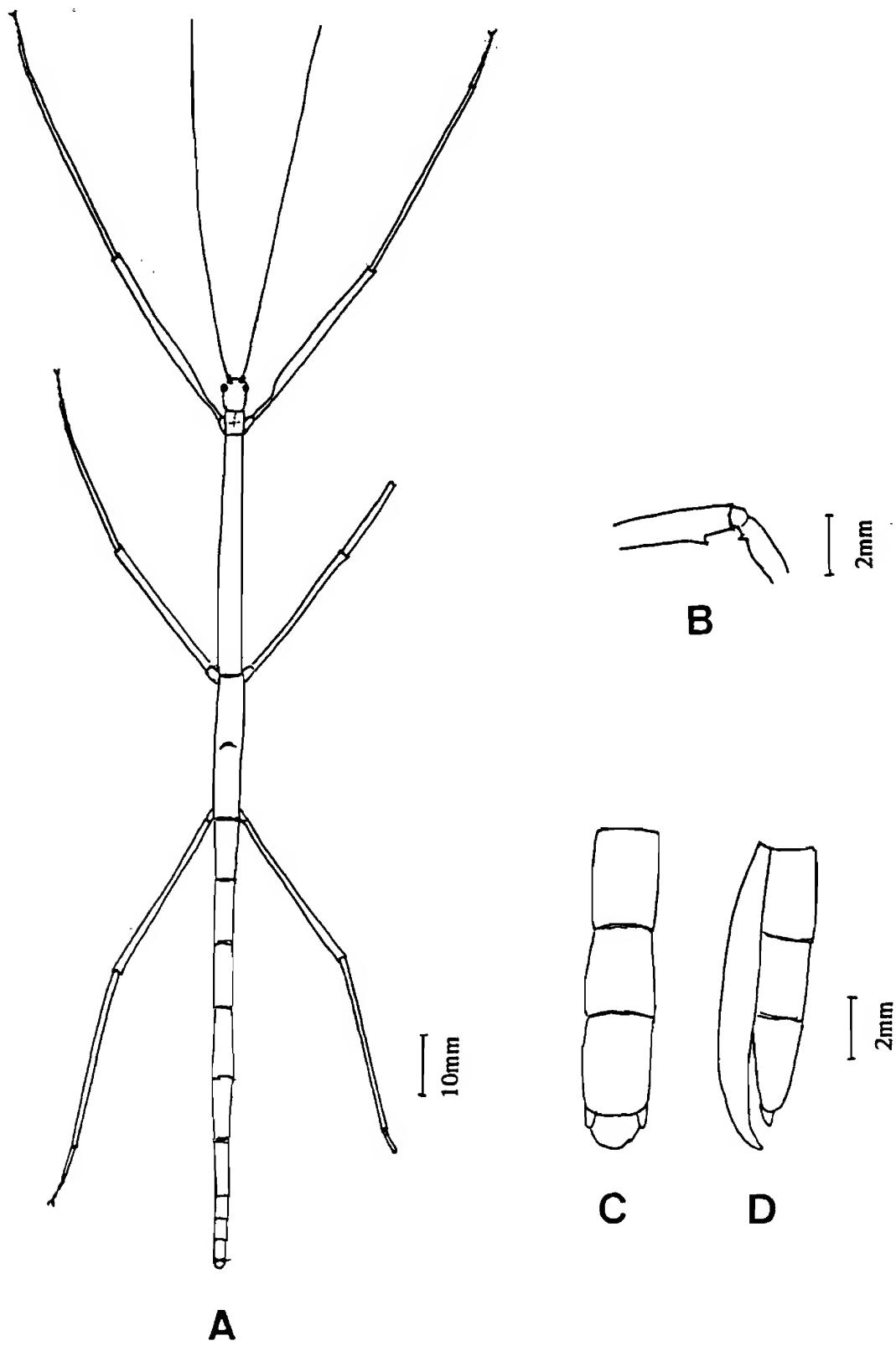


Figure 1. A) holotype female; B) spines on hind leg; C) dorsal view of apex of abdomen; D) lateral view of apex of abdomen.

Legs. Long and slender. Base of fore femora very narrow and incurved, width then broadened to 1.5mm, narrowing to 1mm at apex. All femora with a pair of apical spines and a pair of bold subapical spines (Figure 1b). Tibiae with small subbasal spine; also broadened slightly basally and apically. Tarsi long, normal.

Measurements

Body length 146mm, head 4.7mm, antennae 60mm, pronotum 4mm, mesonotum 39mm, metanotum 12.5mm, median segment 11.5mm, cerci 0.5mm. Femora: fore 31mm, mid 25mm, hind 28mm. Tibiae: fore 34mm, mid 22mm, hind 30mm (right mid tibia broken off). Tarsi: fore 10mm, mid 9mm, hind 10mm.

Notes

The original description by Fabricius is very brief. After keying as "corpo filiformi aptero" (body slender, wingless), he described *filiformes* very simply as follows: "Corpus totum elongatum, filiforme, fulcum pedibus corpore longioribus, filiformibus, simplicibus. Antennae nigrae."

The trustees' catalogue in the Hunterian museum lists four *Mantis filiformes*; however, the person who prepared the catalogue considered all specimens between one label and the next belonged to the species mentioned on the first label. The only species I located which matched the short description is the unique specimen (placed in the far right corner of drawer HUB/15). This specimen has been correctly listed as a *Bacteria* species by some subsequent authors. Whilst it is possible that Fabricius linked various wingless specimens of different species, this is unlikely as his description refers to black antennae, lacking in the other three smaller specimens (amongst which a small specimen was marked holotype, in error).

There has also been some confusion in the literature regarding this species. Most authors have listed the species name as *filiformis*, following Fabricius (1793), whereas it was described by the same author in a lesser known publication, 6 years earlier, as *filiformes*. It is not known if Fabricius was attempting to correct a possible error in his original description. J. Flanagan, a researcher at the Hunterian Museum, also noticed this discrepancy and commented (unpublished manuscript) "*Mantis filiformis* Herbst in Fuessly, 1786 may be a senior homonym [referred to by Fabricius (1793), although he was unaware of Herbst's publication when describing *filiformes*. In any event, Herbst described a different species from India and if Fabricius intended to link the two species, this was in error] but, because of the spelling difference, probably isn't." It is considered that *filiformes* was an "incorrect original spelling" and Fabricius made a "justified emendation" in using *filiformis*. As a junior homonym of *Mantis filiformis* Herbst, 1786, I have renamed the Fabrician insect *Bacteria fabricii* in honour of Fabricius. The type locality translates to South America and whilst linked with the West Indies (including Gray (1835); Redtenbacher (1908) who considered the description was of the male sex), this must be considered doubtful. However, *Bacteria simplicitarsis* Gray, 1835, from Jamaica is very similar, but differs in the shape of the anal segment and operculum.

Acknowledgements

My thanks to Maggie Reilly and Dick Hendry (Hunterian Museum) for access to the collection, and associated notes on the phasmids. Also to Judith Marshall and Peter Barnard (BMNH) for comments on this paper.

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Phasmida in Oceania

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Abstract

Nakata's 1961 paper on phasmids of Oceania is updated. The data is reviewed in a similar format to that of Nakata. A number of new records are included.

Key words

Phasmida, Oceania, distribution.

Introduction

It is some 38 years since Setsuko Nakata (1961) wrote her article on Phasmida in Oceania. Much of the information was obtained from papers by K. Günther since the 1920s. Prior to Nakata's paper the previous paper on the region appeared in 1953. Since 1961 a number of species have been collected in the region and some are in culture. This paper follows a similar format, and is intended to update Nakata's paper.

For the purpose of this paper Oceania includes Micronesia, Melanesia, Polynesia and Lord Howe Island, Chatham Island and New Zealand; Micronesia, East Melanesia, New Caledonia, Polynesia and Lord Howe Island are referred as oceanic islands in the Pacific.

New Guinea, Bismarck Archipelago, Solomon Islands, Louisiade Archipelago.

Herwaarden's 1998 paper on New Guinea phasmids gives 190 species and 17 subspecies; three more have been described subsequently (by Hennemann & Conle, 1998). New Guinea has only two more subfamilies than are found on oceanic islands (Lonchodinae and Aschiphasmatinae) but many more tribes, genera and species. Some genera absent in the oceanic fauna possess numerous species in New Guinea. The genus *Neopromachus* has 48 species, *Dimorphodes* contains 18 species and *Sipyloidea* ten species. There are nine species in the genus *Euryantha* which is primarily restricted to New Guinea, Bismarck Archipelago and Solomon Islands, but a few species occur in Australia and one is known from New Caledonia. In 1993 Beccaloni described a new species of *Extatosoma - carlbergi* - from Wau, Morobe Province of New Guinea. Grösser (1991 & 1992) described three species of *Phyllium - brevipennis, chitoniscoides* and *elegans*.

The Bismarck Archipelago has 18 species recorded belonging to 13 genera. Some six of these species are also known from the Solomon Islands and one each from Micronesia, New Hebrides and New Caledonia. Two species are common to Fiji, while three others are known from the region stretching from the Sunda Islands to New Guinea.

Nakata reported 13 species of eight genera from the Solomon Islands, however Günther (1937) also recorded *Anchiale necydalooides* (Linnaeus) - now a junior synonym of *Phasma gigas* (Linnaeus). In 1977 and 1996, accompanied by Mary Salton, I made two trips to various islands and collected two species, one of the genus *Megacrania* from Rennell Island which may be a different species from those recorded i.e. *M. alpheus* (Westwood) or *M. phelaus* (Westwood). The second was a large winged phasmid possibly of the genus *Vetilia* was found on Gizo Island and New Georgia; efforts to bring this species into culture in 1977 failed. Also *Graeffea coccophaga* (Newport) was recorded by Redtenbacher (1908: 371), but this was probably a misidentification (Paine, 1968: 578) of *Ophicrania leveri* (Günther). One species from the Solomon Islands is now in culture as PSG 186: *Chondrostethus woodfordi* Kirby.

The Louisiade Archipelago, located south of the Bismarcks, has at least three species, one of which is an endemic *Euryantha*.

Southeastern and Central Polynesia

Phasmids have not been recorded from the Hawaiian islands, Easter, Austral, Phoenix or Fanning. The widespread coconut pest, *Graeffea crouanii* (Le Guillou) occurs in the Marquesas and Mangareva, Tuamotus and Society Islands (Tahiti, Bora Bora) and the Cook Islands. A member of the genus *Hermarchus* also occurs on the Society Islands as well as Fiji, New Caledonia and Vanuatu (formerly New Hebrides).

Three species have been recorded in Tonga, one of which is an endemic *Cotylosoma*, a genus restricted to Fiji, Tonga, Tongatabu and Vanuatu. A penultimate instar female nymph of this genus was collected on Choiseul Island, Solomon Islands in 1988 by Evan Bowen-Jones; the specimen is in my collection.

Samoa

Samoa has two species of *Graeffea* recorded: *G. crouanii* and *G. minor* Brunner.

Fiji

Fiji has one of the richest phasmid faunas in the region: 21 species, eight of which are endemic, belonging to 11 genera. A species of the genus *Hermarchus* was cultured by members of the Phasmid Study Group (PSG), the culture is currently tentatively in culture as the result of a re-introduction.

New Caledonia

Nakata reported 24 species of 12 genera in five subfamilies, with Eurycanthinae predominating. In 1988 Donskoff described a new species, *Microcanachus matileorum*. Fifteen species are endemic and all are Eurycanthinae.

Loyalty Islands

Three main islands are close to New Caledonia and have a distinctive fauna of eight species belonging to eight genera.

Vanuatu (New Hebrides)

Seven species and two subspecies belonging to five genera are present in Vanuatu, four are also on Fiji, two on New Caledonia and one each on the Society Islands and New Britain. Two subspecies: *Megacrania batesii speiseri* Carl, and *Hermarchus inermis speiseri* Carl are endemic.

Lord Howe Island

This tiny island has, or had, five species of phasmid, two of which are endemic. They are *Karabidion australis* (Montrouzier) which is now believed to be extinct (Gurney, 1947), and *Parasosibia australica* Redtenbacher, which belongs to the South East Asian subfamily Necrosciinae which is otherwise absent from oceanic islands. Three Australian species also inhabit this island.

Chatham Island and New Zealand

A single species, *Argosarchus horridus* (White), also known from New Zealand, occurs on Chatham Island. Twenty-two species and subspecies are recorded from New Zealand (Salmon, 1991).

Table 1 - Genera found in the region.

| GENERALA | DISTRIBUTION |
|----------------------------|---|
| Family Phyllidae | |
| Subfamily Phyllinae | |
| 1. <i>Chitoniscus</i> | Palau, New Guinea, New Britain, Fiji, New Caledonia, Loyalty Islands. |
| 2. <i>Phyllum</i> | New Guinea. |
| Subfamily Heteropteryginae | |
| Tribe Obrimini | |
| 3. <i>Heterocopus</i> | Palau, Ponape, New Guinea. |
| 4. <i>Pterobrimus</i> | Fiji. |
| Family Phasmatidae | |
| Subfamily Tropidoderinae | |
| Tribe Tropidoderini | |
| 1. <i>Extatosoma</i> | New Guinea, Australia, Tasmania, Lord Howe Island. |
| 2. <i>Didymuria</i> | Australia, Tasmania, Lord Howe Island. |
| 3. <i>Podacanthus</i> | Fiji, Lord Howe Island, Australia. |
| Subfamily Phasmatinae | |
| Tribe Phasmatini | |
| 4. <i>Ctenomorpha</i> | Fiji, Australia, Tasmania. |
| 5. <i>Phasma</i> | Solomon Isles, New Guinea. |
| Tribe Pharnaciini | |
| 6. <i>Gigantophasma</i> | Loyalty Islands. |
| 7. <i>Diagoras</i> | Palau Islands. |
| 8. <i>Hermarchus</i> | Ponape, New Guinea, New Britain, Fiji, New Caledonia, Vanuatu, Society Islands. |
| 9. <i>Cladomimus</i> | Loyalty Islands. |
| Tribe Acanthoxylini | |
| 10. <i>Arphax</i> | Fiji, Eastern Australia. |
| 11. <i>Clitarchus</i> | New Caledonia, New Zealand. |
| 12. <i>Argosarchus</i> | Chatham Island, New Zealand. |
| Subfamily Eurycanthinae | |
| 13. <i>Karabidion</i> | Lord Howe Island. |
| 14. <i>Eurycaantha</i> | New Guinea, Bismarcks, Solomons, New Caledonia [Australia - in error]. |
| 15. <i>Canachus</i> | New Caledonia, Vanuatu, Loyalty Islands. |
| 16. <i>Paracanachus</i> | New Caledonia. |
| 17. <i>Microcanachus</i> | New Caledonia. |
| 18. <i>Asprenas</i> | New Caledonia, Vanuatu, Loyalty Islands. |
| 19. <i>Labidophasma</i> | New Caledonia. |
| 20. <i>Cnipsus</i> | New Caledonia. |
| Subfamily Xeroderinae | |
| 21. <i>Nisyrus</i> | Fiji. |
| 22. <i>Cotylosoma</i> | Fiji, Vanuatu, Tonga, Tongatabu. |
| 23. <i>Leosthenes</i> | New Caledonia, New Guinea. |
| Subfamily Platycraninae | |
| 24. <i>Megacrania</i> | Sri Lanka, Sumatra, Borneo, Philippines, Palau Island, Ponape, New Guinea, Admiralty Islands, Bismarcks, Vanuatu, Fiji. |
| 25. <i>Acanthograeffea</i> | Seychelles to New Guinea, Marianas, Truk, Ponape. |
| 26. <i>Graeffea</i> | New Guinea, Ponape, Australia to Marquesas and Mangareva. |
| 27. <i>Brachyrhamphus</i> | New Caledonia, Loyalty Islands. |
| Subfamily Necrosciinae | |
| 28. <i>Parasosibia</i> | Lord Howe Island, East India, Sri Lanka. |
| 29. <i>Sipyloidea</i> | Solomon Isles. |
| 30. <i>Orthonecroscia</i> | Solomon Isles. |
| Subfamily Pachymorphinae | |
| Tribe Pachymorphini | |
| 31. <i>Pachymorpha</i> | Fiji, New Zealand, East Australia. |

| Taxon | New Zealand | Solomon Is. | Bismarck Arch. | Louisiade Arch. | Mariana Is. | Marshall Is. | Caroline Is. | Lord Howe Is. | New Caledonia | Loyalty Is. | Vanuatu | Fiji | Tonga | Samoa | Cook Is. | Society Is. | Tuamoto Arch. | Mangareva | Marquesas | Other localities | |
|----------------------------|-------------|-------------|----------------|-----------------|-------------|--------------|--------------|---------------|---------------|-------------|---------|------|-------|-------|----------|-------------|---------------|-----------|-----------|------------------|--------------------------|
| Phasmatinae | | | | | | | | | | | | | | | | | | | | | |
| Pharnaciini | | | | | | | | | | | | | | | | | | | | | |
| <i>Hermarchus</i> | | | | | | | | | | | | | | | | | | | | | |
| <i>H. differens</i> | | | | | | | | | | X | | | | | | | | | | | |
| <i>H. apollonius</i> | | | | | | | | X | | | X | | | | | | | | | | |
| <i>H. pythonius</i> | | | | | | | | | X | | X X | | | X | | | | | | | |
| <i>H. virga</i> | | | | | | | | | | | | X | | | | | | | | | |
| <i>H. novabritanniae</i> | X | | | | | | | | | | X X | | | | | | | | | | |
| <i>H. godeffroyi</i> | X | | | | | X | | | | | | | | | | | | | | | |
| <i>H. inermis inermis</i> | | | | | | | | | | | | X | | | | | | | | | |
| <i>H. inermis speiseri</i> | | | | | | | | | | | X | | | | | | | | | | |
| Acanthoxylini | | | | | | | | | | | | | | | | | | | | | |
| <i>Clitarchus</i> | | | | | | | | | | | | | | | | | | | | | |
| <i>C. hookeri</i> | X | | | | | | | | X | | | | | | | | | | | | |
| Eurycanthinae | | | | | | | | | | | | | | | | | | | | | |
| <i>Euryantha</i> | | | | | | | | | | | | | | | | | | | | | |
| <i>E. horrida</i> | X | X | X | | | | | | | | | | | | | | | | | | New Guinea |
| <i>E. calcarata</i> | X | X | | | | | | | X | | | | | | | | | | | | New Guinea |
| <i>E. portentosa</i> | | | | X | | | | | | | | | | | | | | | | | |
| <i>E. insularis</i> | X | X | | | | | | | | | | | | | | | | | | | New Guinea |
| <i>E. sifia</i> | | | | | | | | | | | | | | | | | | | | | Australia [Thursday Is.] |
| <i>Canachus</i> | | | | | | | | | | | | | | | | | | | | | |
| <i>C. alligator</i> | | | | | | | X | | | | | | | | | | | | | | |
| <i>C. crocodilus</i> | | | | | | | X | | | | | | | | | | | | | | |
| <i>C. harpyia</i> | | | | | | | X | | | | | | | | | | | | | | |
| <i>C. salamandra</i> | | | | | | | X | | | | | | | | | | | | | | |
| <i>C. tyrrhaeus</i> | | | | | | | | X | X X | | | | | | | | | | | | |
| <i>Paracanachus</i> | | | | | | | | | | | | | | | | | | | | | |
| <i>P. cerce</i> | | | | | | | X | | | | | | | | | | | | | | |
| <i>Microcanachus</i> | | | | | | | | | | | | | | | | | | | | | |
| <i>M. matileorum</i> | | | | | | | | X | | | | | | | | | | | | | |
| <i>Asprenas</i> | | | | | | | | | | | | | | | | | | | | | |
| <i>A. gracilipes</i> | | | | | | | | X | | | | | | | | | | | | | |
| <i>A. femoratus</i> | | | | | | | | X | | | | | | | | | | | | | |
| <i>A. brunneri</i> | | | | | | | | X | | | | | | | | | | | | | |
| <i>A. dubius</i> | | | | | | | | X | | | | | | | | | | | | | |
| <i>A. impennis</i> | | | | | | | | X | | | | | | | | | | | | | |
| <i>A. sarasini</i> | | | | | | | | X | | | | | | | | | | | | | |
| <i>A. effeminatus</i> | | | | | | | | X | | | | | | | | | | | | | |
| <i>A. spinivestris</i> | | | | | | | | | X | | | | | | | | | | | | |
| <i>A. crassipes</i> | | | | | | | | | | X | | | | | | | | | | | |

Table 2. Updated version of Nakata's (1961) Table 2. The distribution of the species in four widespread genera: *Hermarchus*, *Euryantha*, *Megacrania* and *Graeffea*, and four restricted genera: *Clitarchus*, *Canachus*, *Asprenas*, and *Cotylosoma*.

| Taxon | New Zealand | Solomon Is. | Bismarck Arch. | Louisiade Arch. | Mariana Is. | Marshall Is. | Caroline Is. | Lord Howe Is. | New Caledonia | Loyalty Is. | Vanuatu | Fiji | Tonga | Samoa | Cook Is. | Society Is. | Tuamotu Arch. | Mangareva | Marquesas | Other localities |
|---------------------------|-------------|-------------|----------------|-----------------|-------------|--------------|--------------|---------------|---------------|-------------|---------|------|-------|-------|----------|-------------|---------------|-----------|-----------|------------------------------------|
| <i>Xeroderinae</i> | | | | | | | | | | | | | | | | | | | | |
| <i>Corylosoma</i> | | | | | | | | | | | | | | | | | | | | |
| <i>C. godeffroyi</i> | | | | | | | | | | | | | X | | | | | | | |
| <i>C. sp. indet.</i> | X | | | | | | | | | | | | | | | | | | | |
| <i>C. dipneusticum</i> | | | | | | | | | | | | | X | | | | | | | |
| <i>C. amphibius</i> | | | | | | | | | | | | | X | X | X | | | | | |
| <i>C. carlottae</i> | | | | | | | | | | | | | X | X | | | | | | |
| <i>Platycraninae</i> | | | | | | | | | | | | | | | | | | | | |
| <i>Megacrania</i> | | | | | | | | | | | | | | | | | | | | |
| <i>M. batesi batesi</i> | X | | | | X | X | | | | | | | | | | | | | | Admiralty Is., Key Is., New Guinea |
| <i>M. batesi speiseri</i> | | | | | | | | | | | X | | | | | | | | | |
| <i>M. alpheus</i> | X | | | | | | | | | | | | | | | | | | | Sri Lanka, Aru Is., Philippines |
| <i>M. pellaus</i> | | | | | | | | | | | | X | | | | | | | | |
| <i>Graeffea</i> | | | | | | | | | | | | | | | | | | | | |
| <i>G. crouanii</i> | | | | | X | X | | | X | X | X | X | X | X | X | X | X | X | X | |
| <i>G. lifuensis</i> | | | | | | | X | | | | | | | | | | | | | |
| <i>G. minor</i> | | | | | | | | | | | X | X | | | | | | | | |

Table 2 (continued - caption on page 16).

Micronesia

There are few records for phasmids in Micronesia with seven having been recorded from Caroline Islands (four from Ponape, one from Truk, four from Palau), one from the Mariana Islands (Pagan, Saipan, Rota and Guam) and one from the Marshall Islands. The five endemic species in Micronesia are distributed as follows: *Diagoras ephialtes* Stål in Palau, *Acanthograeffea denticulata* Redtenbacher in the Mariana Islands, *A. modesta* Günther in Truk, *Hermarchus godeffroyi* Redtenbacher in Ponape and *Heterocopus leprosus* Redtenbacher from Palau and Ponape Islands. A species of *Megacrania* is found on Ebon Atoll, Marshall Islands (Gressitt, 1954) and one species *Graeffea* on Angaur, Palau Islands (Esaki, 1940). A species of *Chitoniscus* is reported and a species of *Diagoras* is endemic to Palau Island.

| | |
|------------------------|------------------------------------|
| <i>Argosarchus</i> | Chatham Island, New Zealand. |
| <i>Acanthoxyla</i> | New Zealand. |
| <i>Pseudoclitarhus</i> | New Zealand. |
| <i>Clitarhus</i> | New Caledonia, New Zealand. |
| <i>Pachymorpha</i> | Fiji, New Zealand, East Australia. |
| <i>Mimarchus</i> | New Zealand. |
| <i>Tectarchus</i> | New Zealand. |
| <i>Spinotecarchus</i> | New Zealand. |

Table 3 - Distribution of New Zealand genera.

Discussion

Since the publication of Nakata's paper several trips have been made by PSG members to various islands in the region. Tony James has visited Fiji and New Caledonia; a species of the genus *Hermarchus* was brought into culture and remained so for a number of years. For myself, I have been fortunate enough to visit the region on a number of occasions: New Guinea (twice), Solomon Islands (twice), Fiji, Vanuatu, New Caledonia, New Zealand and the Loyalty Islands. Numerous species were collected in New Guinea including members of the genera: *Euryantha*, *Anchiale*, *Phasma*, *Neopromachus*, *Extatosoma*, and various unidentified species. Of these *Euryantha calcarata* is still in culture, *Extatosoma popa* and *Phasma gigas* are currently tentatively back in culture. *Anchiale maculata* is unfortunately no longer in culture. Other species have been acquired via various agencies and *Euryantha coriacea* and *E. sp.* (PSG 44) are in culture. Efforts to culture *Hermarchus biroi* by several PSG members failed when nymphs refused all foodplants.

Two visits to various islands of the Solomon resulted in the following species being collected: *Megacrania* sp., one series from New Georgia and one from Rennell Island, *Sipyloidea poeciloptera*, *Orthonecroscia ruficeps*, *Hermarchus godeffroyi*, a *Vetilia* sp. and *Chondrostethus woodfordi*. Only the last species is in culture, it is a fern eating species. In the case of the other species only *Vetilia* sp. laid sufficient eggs to start a culture. However, the eggs failed to hatch.

Some observations on the biology of the phasmids have been made. Paine (1967) reported *C. woodfordi* (as *Myronides woodfordi*) frequently in the forest and collected from palms. He was unable to determine the foodplant which I determined to be ferns of various species on New Georgia and Guadalcanal. It was also seen to be feeding on an undetermined dicotyledonous plant, and was diurnally active. *Hermarchus godeffroyi* was stated by Paine to feed on *Hibiscus tiliaceus* though my efforts to feed the insects in captivity failed. The species of *Vetilia* was found on an isolated guava tree (*Psidium guajava*). The foodplants of the *Sipyloidea* and *Orthonecroscia* were not discovered.

On Vanuatu two species of phasmids were discovered. A *Hermarchus* sp. from Erromango Island which is currently tentatively in culture feeding on the following foodplants - bramble (*Rubus* sp.), evergreen oak (*Quercus sobus*), and *Eucalyptus gunnii*. A species of *Graeffea* was found on Efate Island feeding on *Pandanus* palms principally, although *Cocos nucifera* was an alternative foodplant in the wild. This is tentatively being reared on *Euterpe* sp., a South American palm.

Searching on Lifu Island, one of the Loyalties, produced no phasmids. Collecting on Mount Koghi in New Caledonia resulted in several specimens of *Canactus* being found but unfortunately they produced no eggs and, because of the travel arrangements being via New Zealand, they were released.

No species have been recently collected in New Zealand (an attempt by Virginia Cheeseman to culture *Pachymorpha hystericula* (Westwood) in 1991 was unsuccessful) although *Acanthoxyla inermis*, *A. geisovii* and *Clitarchus hookeri* are established in southwestern England and the Scilly Isles. These three species have proved to be difficult to culture in captivity indoors, though less difficult if reared outside, and feed on rose, loganberry, hawthorn, and *Cryptomeria* sp.

I have no doubt that intensive collecting in New Guinea and especially in Irian Jaya (politically part of Indonesia) will produce many species, some of which will undoubtedly be new to Science.

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A Report on a Culture of *Phasma gigas* from New Ireland

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Distribution notes and synonymy by P.E. Bragg.

Abstract

A report of a culture of *Phasma gigas* found in New Ireland, brought into the UK and bred by Stan Pack. This paper gives details of the phenotype of the male and female, their life cycle, and number of eggs produced.

Key words

Phasmida, *Phasma gigas*, New Ireland, Descriptions, Male, Female, Eggs, Life Cycle, Defence, Rearing.

Introduction

The culture of *Phasma gigas* discussed here originates from a batch of eggs that was brought back from Kavieng, New Ireland, an island within the Bismarck Archipelago some 400 miles north of the Papua New Guinea mainland, by a individual who was working in the country. These were passed on to Stan Pack who, with the help of other members of the Phasmid Study Group, proceeded to breed them efficiently and pass them on to other members. There are currently two phenotypes of *Phasma gigas* in culture, the original culture bred by Stan Pack and another that was bought as a batch of eggs by Allan Harman and Ian Abercrombie, which originated from Wau, in the Marobi Province of Papua New Guinea. The culture established by Ian and Allan appears easier to breed than Stan's, with a much lower 1st instar death rate of around 30%. They are almost identical apart from the fact that Ian and Allan's *Phasma gigas* is more spinulose on the dorsal surface of the thorax. The culture described here is the one introduced by Stan Pack.

Distribution of *Phasma gigas*

As one of the oldest known, and one of the largest species of phasmid, *P. gigas* has been recorded many times (see below), although many of the pre-1900 mentions are only reiteration of earlier publications rather than new records. Since few phasmids were known until the mid-1800s some of the early records may relate to misidentified material, consequently some early records may be incorrect. When taken in conjunction with the unreliable and vague locality records of some old material, it is not surprising that the recorded distribution of this species appears to cover a much wider area than recent records suggest. The recorded distribution includes many of the islands east of the Wallace Line, from Sulawesi to New Guinea and New Britain; records for Java, Sumatra and Borneo (Redtenbacher, 1908: 467) are rather suspect. I have done a lot of work on Bornean material and have never located a specimen from Borneo, the record (based on a specimen in Budapest museum - now destroyed - Redtenbacher, 1908)) is almost certainly an error. Similarly, Java and Sumatra were important trading areas in the 19th century, material collected elsewhere could easily have been sent on from Java or Sumatra without any original data.

The inadequate descriptions of early species has led to various opinions about synonyms of this species. The following synonymy is in many ways no more than my best guess, based on synonymies given by other authors: I have not examined the original specimens.

Phasma gigas (Linnaeus, 1758)

Gryllus (Mantis) gigas, Linnaeus, 1758: 425; Linnaeus, 1766: 689. Syntypes ♂, nymph (UZI) Amboina.

Gryllus gigas (Linnaeus); Shaw, 1790-1813: pl. 43 [not seen].

Mantis gigas (Linnaeus); Fabricius, 1775: 14; Olivier, 1792: 625; Donovan, 1800: pl. 9 (♀).

Phasma gigas (Linnaeus); Stoll, 1813: 1, pl. 1.1 (♀) & 6, pl. 2.5 (♀); Thunberg, 1815: 296; Fabricius, 1798: 187; Lichtenstein, 1802: 11; Cuvier, 1845: pl. 80 (♀); Burmeister, 1838: 579; Beauvois, 1805: 109, pl. 13.1 (♀); Kirby, 1904b: 390; Günther, 1933: 159; Herwaarden, 1998: 86, fig 11.1 (♂).

Spectrum gigas (Linnaeus); Lamarck, 1817: 254.

Phasma (Cyphocrania) gigas (Linnaeus); de Haan, 1842: 129, pl. 14.3.

Cyphocrana gigas (Linnaeus); St Fargeau & Serville, 1825: 445; Serville, 1831: 60; Gray, 1835: 35; Blanchard, 1840: 15.

Cyphocrania gigas (Linnaeus); Burmeister, 1838: 579; Westwood, 1859: 106; Kaup, 1871: 21, pl. 1.17 (egg); Redtenbacher, 1908: 467, pl. 23.9.

Cyphocrania gigas var.; Westwood, 1859: 107. [Synonymised with *P. empusa* by Kirby, 1904b: 391.]

Phasma necydalooides Thunberg, 1815: 296 [not *P. necydalooides* Stoll, 1813]. Synonymised by Kirby, 1904b: 390.

Phasma empusa Lichtenstein, 1796: 77; Lichtenstein, 1802: 12; Kirby, 1904a: 439; Kirby, 1904b: 390. Synonymised by Redtenbacher, 1908: 467.

Cyphocrana empusa (Lichtenstein); Gray, 1835: 35; Serville, 1838: 237.

Cyphocrania empusa (Lichtenstein); Burmeister, 1838: 579.

Cyphocrana bauvoisi Serville, 1831: 60 [Replacement name for *Phasma gigas* Beauvois, 1805: 109, pl. 13.1 (not Linnaeus, 1758)]. Synonymised with *P. gigas* by Redtenbacher, 1908: 467.

Cyphocrania beauvoisii Serville [corrected spelling of *bauvoisi*]; Burmeister, 1838: 579; Westwood, 1859: 108.

Eurycnema (?) *beauvoisi* (Serville); Kirby, 1904b: 392. [emended spelling].

? *Cyphocrania goliath* var. de Haan, 1842: 128. Given as a possible synonym by Redtenbacher, 1908: 467.

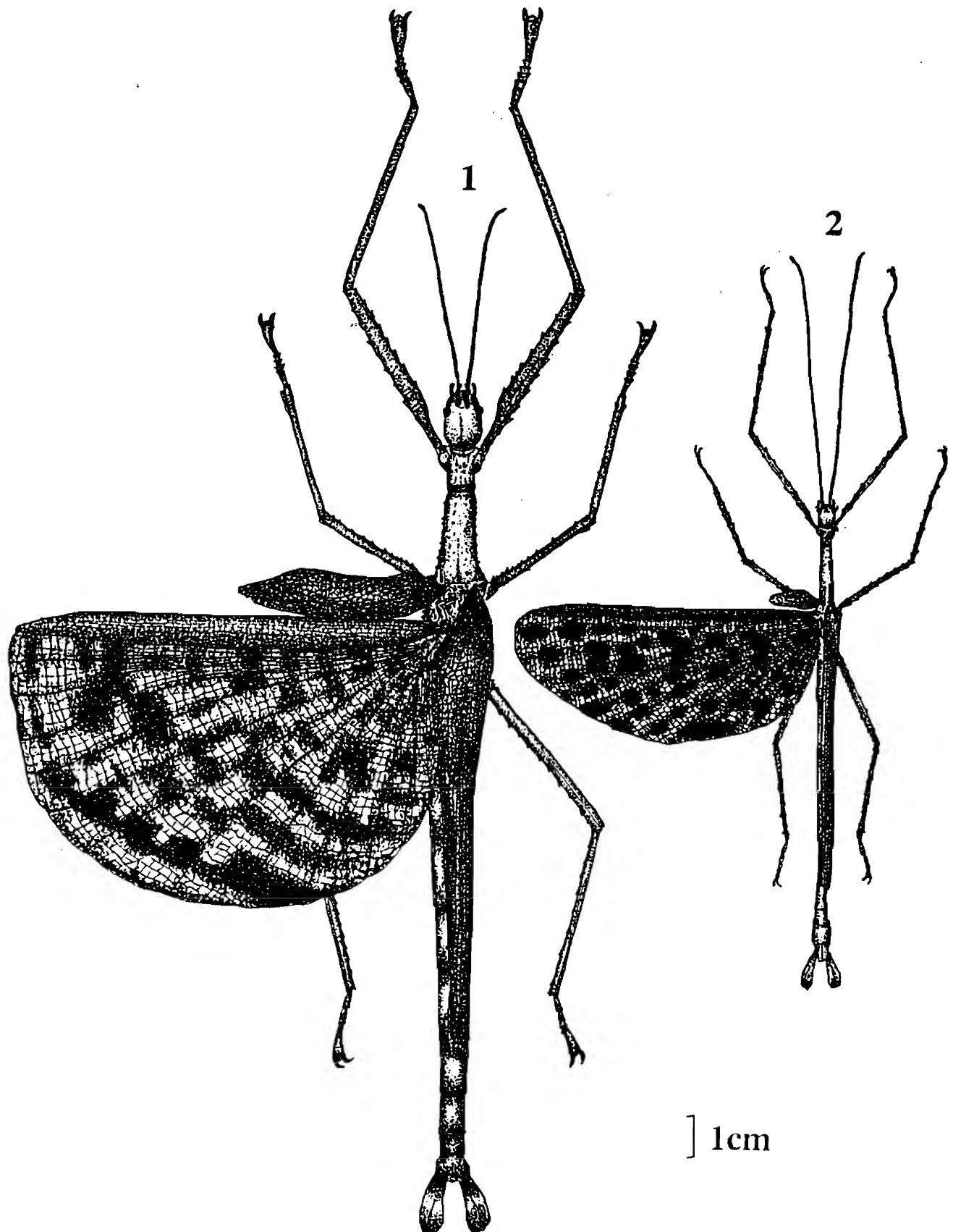
[Redtenbacher, 1908: 460 treated *Mantis necydalooides* Linnaeus as a junior synonym of *Anchiale maculata* (Olivier, 1792)]

Description of the male (Figure 2)

My male of *Phasma gigas* measured 114mm long. It has a typical body shape of an insect of the genus *Phasma*, and is very similar in shape to *Acrophylla* spp. The mesothorax is dentate, with small projections covering the dorsal and ventral surface. The carinae of the legs are serrated with medium-sized spines, which are irregularly spaced along the length of both the femur and tibia of all the legs. The antennae of the male are 60mm long, and are covered with a dense layer of sensory hairs. The head of the male is almost spherical, being 4mm wide and 5mm long. The male exhibits large compound eyes, as well as large ocelli. The elytra are very small (13mm long) and exhibit a very pronounced longitudinal ridge, which is also found in other members of Phasmatidae. The hind-wing of the male almost covers the length of the abdomen, reaching to the base of the 7th abdominal segment, with the costal margin of the wing being a very light brown colour. The wingspan of the male is 77mm, with the wing exhibiting a dark chequered pattern, as found in certain winged members of Phasmatidae, such as *Acrophylla titan* and *Acrophylla wuelfingii*. At the tip of the abdomen, there is a large bulbous projection, comprising of the 9th abdominal segment, the anal segment and the subgenital plate. The cerci of the male are very pronounced, are 8-9mm long, and are paddle-shaped with a distinct keel along the dorsal surface. The external genitalia of the male are very pronounced, with the poculum of the male having a large bump on the ventral surface.

Description of the female (Figure 1)

My female of *Phasma gigas* measured 193mm long and, like the male, it has a typical body shape of the genus *Phasma*. The mesothorax is dentate, with small projections over both the dorsal and ventral areas. Like the male, the carinae of the legs are heavily serrated with large spines, which the female uses in her defensive routine. Unlike the male, the female's antennae are 48mm long, and do not exhibit the sensory hairs to any great degree, although some are still present. The female's head is much more oval than the male, with a length of 14mm, with smaller compound eyes in ratio to the head size. The female has ocelli as the male does, but they are much smaller in relation to the size of her head. The elytra of the female are much bigger in comparison to the male, reaching down to the base of the 2nd abdominal segment. The hind-wings of the female are 110mm long, and are patterned in the



Figures 1-2. *Phasma gigas*: 1. Female, 2. Male.

same way as the males, but are much darker. The ventral surface is a light brown colour. Although the female has large wings she cannot fly as well as the male can, but was observed to glide short distances. The female has large paddle-shaped cerci with a length of around 13mm.

Description of the egg

The egg of *Phasma gigas* is around 4mm long. The surface of the egg is a mottled brown colour, and upon closer inspection by means of a microscope, there are dark spots covering the surface of the egg. The micropylar plate extends along the dorsal area of the egg, and is around 3mm long. The micropyle of the egg is situated at the base of the plate. The surface of the egg is covered with small dents, resembling the surface of a golf ball, and small vein-like projections are scattered over the surface of the egg, including the micropylar plate.

Life Cycle and Rearing

The eggs take approximately 6 months to hatch at 20°C and 60% humidity. At these settings, there is a hatch rate of 60-70%. If kept too humid, many of the eggs will not hatch due to bacterial and fungal infection. I found that the best way to keep the eggs was to use a 2:1 substrate ratio between fine grain vermiculite and sifted peat that had been heated in a oven beforehand to kill small insects and possible bacteria. The substrate and eggs should then be sprayed lightly daily and kept at a temperature of 20°C. The 1st instar nymph is approximately 11mm long and a bright green. At this stage, many of the nymphs die for various reasons, with a survival rate of 40-50% depending on the conditions they are kept in. Surviving nymphs will moult roughly each month, increasing their length by approximately 1/3, each time. It is difficult to tell the male and female nymphs apart when they are small, but once they reach the 3rd and 4th instar, the males become easy to identify as they have a large bump situated on the ventral surface of the abdomen at the tip. Nymph fatalities are often high in the early stages (almost 60%), and many methods have been tried to reduce this. The most successful so far has been to keep the nymphs at 40-50% humidity, with air circulation through the cage, which can be provided by a small fan easily purchased at hardware stores. Care must be taken if cold water is used to spray the foodplant, the nymphs may chill if they become wet and the fan is on – I found that tepid water worked best, with half an hour allowed for the water to evaporate before putting the fan on again. The most accepted foodplants are *Rosa* sp., *Quercus* sp., *Eucalyptus* sp. and Bramble. The wing buds become pronounced towards the 5th instar, but the adult coloration of the wings is not present until approximately a week before the final moult. The adults are fairly long lived, surviving roughly 7 months, with the females laying 300-400 eggs in their life-span.

Defences

The nymphs of *Phasma gigas* have little defence from predators, with their main method being to remain hidden in undergrowth, but when disturbed they will move rapidly for a short distance to evade the would-be predator. Another form of defence, particularly if handled roughly, is that they are prone to losing legs and because of this great care they should be take when handling young nymphs. As they reach the 5th instar they become more aggressive, using their spiny legs to scratch the handler, and moving in such a way that they risk falling from the handler's hands. The adults have many more methods of protecting themselves compared to the nymphs. Adult males will remain hidden effectively, but if disturbed will move rapidly for a short distance, and if possible, they will fly away from the area for quite a long distance. Females are far more aggressive compared to the males, using their heavily spined legs to cause injury to the attacker, and using their wings in a flash display in order to startle the predator. If the female is handled further, she is capable of producing a loud screeching noise; although it is not known how this is done. She is also capable of biting the aggressor, but this is only done in extreme cases of

stress.

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Reviews and Abstracts.

Phasmid Abstracts

The following abstracts briefly summarise articles which have recently appeared in other publications. Some of these may be available from local libraries. Others will be available in university or college libraries, many of these libraries allow non-members to use their facilities for reference purposes free of charge.

The editor of *Phasmid Studies* would welcome recent abstracts from authors so that they may be included in forthcoming issues. In the case of publications specialising in phasmids, such as *Phasma*, only the longer papers are summarised.

Ali, D.W. & Darling, D.C. (1998) Neuroanatomy and neurochemistry: Implications for the phylogeny of the lower Neoptera. *Canadian Journal of Zoology*, **76**(9): 1628-1633.

Physiologists and developmental biologists routinely collect data that, when analyzed from a phylogenetic perspective, may improve our understanding of the evolutionary relationships of many enigmatic groups of organisms. Immunohistochemical studies of the innervation of the salivary glands provide data that clarify the evolutionary relationships of the lower Neoptera, a major unresolved issue in our understanding of insect phylogeny. Support for the hypothesis that the Phasmatodea and Orthoptera are sister taxa is provided by the dorsal position of the cell body of salivary neuron 1 in the subesophageal ganglion and the presence of serotonin in salivary neuron 2.

Basset, Y. & Novotny, V. (1999) Species richness of insect herbivore communities on *Ficus* in Papua New Guinea. *Biological Journal of the Linnean Society*, **67**(4): 477-499.

Insect herbivores were sampled from the foliage of 15 species of *Ficus* (Moraceae) in rainforest and coastal habitats in the Madang area, Papua New Guinea. The collection included 13193 individuals representing 349 species of leaf-chewing insects and 44 900 individuals representing 430 species of sap-sucking insects. Despite a high sampling intensity, the species accumulation curve did not reach an asymptote. This pattern was attributed to the highly aggregated distribution of insects on individual host trees. The number of insect species collected on a particular *Ficus* species ranged from 34 to 129 for leaf-chewing and from 51 to 219 for sap-sucking insects. Two *Ficus* species growing on the seashore sustained less speciose insect communities than their counterparts growing in forest. For the forest figs, significant predictors of insect species richness included leaf palatability and leaf production for leaf-chewing insects (40% of the variance explained), and tree density and leafexpansion for sap-sucking insects (75%). The high faunal overlap among *Ficus* communities and the importance of local resources for insect herbivores suggest that highly specialized interactions between insect herbivores and *Ficus* in Papua New Guinea have not been conserved in evolutionary time. This is at variance with the dogma of old, extremely specialized and conservative interactions between insect herbivores and their hosts, providing numerous ecological niches in the floristically rich tropics.

Bianchi, A.P. & Meliado, P. (1998) Analysis of the karyotypes of four species of the *Leptynia attenuata* complex (Insecta Phasmatodea). *Caryologia*, **51**(3-4): 207-219.

Karyotypes of several bisexual populations of the *Leptynia attenuata* complex were analysed. This complex includes four karyotypically differentiated taxa: *Leptynia attenuata* s.str., *Leptynia montana*, *Leptynia caprai* and *Leptynia* sp. The chromosome numbers of the

four species are: $2n=36$ (male XY; female XX) for *Leptynia attenuata*, $2n=38$ (male X0; female XX) for *Leptynia montana*, $2n=40$ (male X0; female XX) for *Leptynia caprai* and $2n=40$ (male X0; female XX) for *Leptynia* sp. The evolutionary relationships between the four species are discussed.

Brock, P.D. (1997) Catalogue of stick-insect (Insecta: Phasmida) type material in the Museo Regionale di Scienze Naturali, Torino. *Museo Regionale di Scienze Naturali Bollettino (Turin)*, 15(2): 299-312.

This Catalogue lists all type species of stick-insects in the Museo Regionale di Scienze Naturali, Torino collection. Genera are listed in taxonomic order, with species then listed in alphabetical order within genera. Type localities, sex of type, or details of syntype series are provided, with 20 lectotypes designated. *Oreophoetes gramen* (Giglio-Tos) is listed as a new synonym of *Oreophoetes peruana* (Saussure). The bibliography includes all references relating to descriptions of species recorded in this paper.

Brock, P.D. (1998) Type material of stick-insects (Insecta: Phasmida) in the Zoological Museum, University of Copenhagen. *Steenstrupia*, 24(1): 23-35.

A list of all stick-insect type material lodged in the Zoological Museum, University of Copenhagen is given (12 species: 5 described by J. C. Fabricius, 6 by Westwood, and 1 by Chopard), with illustrated redescriptions of four Fabrician species. Lectotypes are designated for five species: *Mantis calamus* Fabricius, 1793; *Mantis rosea* Fabricius, 1793; *Necroscia ismene* Westwood, 1859 (all ZMUC); *Phibalosoma phyllocephalum* Westwood, 1859 (OXUM); and *Mantis bispinosa* Fabricius, 1775 (HMUG). *Bacteria aurita* Burmeister, 1838 is designated type species of the genus *Otocrania* Redtenbacher, 1908 and *Bacteria crudelis* Westwood, 1859 is listed as a new synonym of *Bacteria ferula* (Fabricius, 1793); as *B. crudelis* is the type species of *Pseudobacteria* Saussure, 1872, *Pseudobacteria* becomes a new synonym of *Bacteria* Latreille et al., 1827. General observations are made in relation to the type collection and main personalities involved, along with brief notes on non-type material and a list of all Fabrician type material.

Giorgi, F., Cecchettini, A., Falleni, A., Masetti, M. & Gremigni, V. (1998) Vitellogenin is glycosylated in the fat body of the stick insect *Carausius morosus* and not further modified upon transfer to the ovarian follicle. *Micron*, 29(6): 451-460.

Synthesis and secretion of vitellogenin (Vg) polypeptides were studied in egg-laying females of the stick insect *Carausius morosus* following in vivo exposure to (35S)-methionine and acetyl-N-(3H)-glucosamine. The specificity of radioisotope incorporation was assessed by in vitro inhibition with tunicamycin and carbohydrate extraction with endo-glycosidase H. Vg polypeptides change in molecular weight during synthesis in the fat body and are not further modified upon transfer to the haemolymph or to the oocyte, suggesting that they are already fully glycosylated prior to secretion. Radioactivity in the fat body was initially distributed over cisternae of the rough endoplasmic reticulum and gradually transferred to the Golgi apparatus. Within an hour of exposure, electron-dense granules budding from the trans-Golgi network became preferentially labeled. Radioactivity in the ovarian follicle was restricted to the yolk granules of the cortical ooplasm and to the amorphous material lying within the intercellular channels of the follicular epithelium. This amorphous material was also shown to react positively when tested with a monoclonal antibody raised specifically against a Vg polypeptide.

Hess, D. & Bueschges, A. (1999) Role of proprioceptive signals from an insect femur-tibia joint in patterning motoneuronal activity of an adjacent leg joint. *Journal of Neurophysiology (Bethesda)*, **81**(4): 1856-1865.

Interjoint reflex function of the insect leg contributes to postural control at rest or to movement control during locomotor movements. In the stick insect (*Carausius morosus*), we investigated the role that sensory signals from the femoral chordotonal organ (fCO), the transducer of the femur-tibia (FT) joint, play in patterning motoneuronal activity in the adjacent coxa-trochanteral (CT) joint when the joint control networks are in the movement control mode of the active behavioral state. In the active behavioral state, sensory signals from the fCO induced transitions of activity between antagonistic motoneuron pools, i.e., the levator trochanteris and the depressor trochanteris motoneurons. As such, elongation of the fCO, signaling flexion of the FT joint, terminated depressor motoneuron activity and initiated activity in levator motoneurons. Relaxation of the fCO, signaling extension of the FT joint, induced the opposite transition by initiating depressor motoneuron activity and terminating levator motoneuron activity. This interjoint influence of sensory signals from the fCO was independent of the generation of the intrajoint reflex reversal in the FT joint, i.e., the "active reaction," which is released by elongation signals from the fCO. The generation of these transitions in activity of trochanteral motoneurons barely depended on position or velocity signals from the fCO. This contrasts with the situation in the resting behavioral state when interjoint reflex action markedly depends on actual fCO stimulus parameters, i.e., position and velocity signals. In the active behavioral state, movement signals from the fCO obviously trigger or release centrally generated transitions in motoneuron activity, e.g., by affecting central rhythm generating networks driving trochanteral motoneuron pools. This conclusion was tested by stimulating the fCO in "fictive rhythmic" preparations, activated by the muscarinic agonist pilocarpine in the otherwise isolated and deafferented mesothoracic ganglion. In this situation, sensory signals from the fCO did in fact reset and entrain rhythmic activity in trochanteral motoneurons. The results indicate for the first time that when the stick insect locomotor system is active, sensory signals from the proprioceptor of one leg joint, i.e., the fCO, pattern motor activity in an adjacent leg joint, i.e., the CT joint, by affecting the central rhythm generating network driving the motoneurons of the adjacent joint.

Langlois, F. & Lelong, P. (1998) Two Phasmatodea from Guadeloupe: *Melophasma antillarum* (Caudell, 1914) n.comb. and *Hesperophasma pavisae* n.sp. (Phasmatodea). *Bulletin de la Societe Entomologique de France*, **103**(5): 451-455. [In French]

Description and illustration of two species of Phasmatodea from Guadeloupe: *Melophasma antillarum* (Caudell, 1914) n.comb. and *Hesperophasma pavisae* n.sp. A description of the eggs of *M. antillarum* is also provided. The validity of the genus *Melophasma* is discussed and reaffirmed.

Lelong, P. & Langlois, F. (1998) *Lamponius lethargicus* n.sp., *Pseudobacteria donskoffi* n.sp. and *Paraclonistria nigramala* n.gen., n.sp.: Three new Phasmids from Guadeloupe (Orthoptera, Phasmatodea). *Bulletin de la Societe Entomologique de France*, **103**(3): 245-254.

[The publication details were omitted when the abstract of this paper was published in *Phasmid Studies* 7(2): 70.]

Locci, M.T., Masetti, M., Cecchettini, A. & Giorgi, F. (1998) Cells released in vitro from the embryonic yolk sac of the stick insect *Carausius morosus* (Br.) (Phasmatodea: Heteronemiidae) may include embryonic hemocytes. *International Journal of Insect Morphology and Embryology*, **27**(4): 325-331.

The embryonic yolk sac and the adult dorsal vessel of the stick insect *Carausius morosus* (Br.) (Phasmatodea: Heteronemiidae) were shown to release a number of cells that appear morphologically similar to circulating adult hemocytes. Like adult hemocytes, these cells reacted positively when tested for both phenoloxidase activity and a monoclonal antibody specifically raised against a vitellin polypeptide. Based on this evidence, it is suggested that yolk sac-released cells behave as potential embryonic hemocytes. A model is thus proposed whereby the yolk sac might host a number of hemopoietic stem cells on their way to the dorsal vessel, and in so doing, it may temporally act as an embryonic hemopoietic organ.

Lorenz, M.W., Hoffmann, K.H. & Gade, G. (1999) Juvenile hormone biosynthesis in larval and adult stick insects, *Carausius morosus*. *Journal of Insect Physiology*, **45**(5): 443-452.

Corpora allata (CA) from adult egg-carrying Indian stick insects, *Carausius morosus*, synthesise and release juvenile hormone (JH) III in vitro. No JH biosynthesis was observed in larvae, young adults, and old adult females that do not carry sclerotised eggs. In females, which bear sclerotised eggs, a consistent JH biosynthesis was observed. Supplementation of precursors of JH biosynthesis (farnesol, mevalonic acid lactone) greatly enhanced JH biosynthesis in a stage-, age-, and dose-dependent manner, but CA from the last larval instar retained the biosynthesised JH within the gland. Elevated calcium concentration in the incubation medium stimulated JH biosynthesis by CA from older adults but had either no or a poor effect on CA from young adults and larvae. The results obtained with farnesol, mevalonic acid lactone, and calcium indicate that the rate-limiting steps of JH biosynthesis very likely occur before the formation of mevalonic acid and that these early steps cannot be stimulated by elevated calcium concentrations in larvae and young adults. In older adults, in which spontaneous JH biosynthesis occurs, elevated calcium concentration can markedly stimulate JH biosynthesis. A pre-purified extract from brains of adult females had a stimulating effect on JH biosynthesis by CA from adult females. The results indicate that JH biosynthesis in *C. morosus* may require food-derived farnesol and may be regulated by allatotropic signals from the brain, possibly triggered by sclerotised oocytes in the ovary. Sum

Maekawa, K., Kitade, O. & Matsumoto, T. (1999) Molecular phylogeny of orthopteroid insects based on the mitochondrial cytochrome oxidase II gene. *Zoological Science (Tokyo)*, **16**(1): 175-184.

Phylogenetic relationships among 18 species of orthopteroid insects (Blattaria: cockroaches, Isoptera: termites, Mantodea: mantids, Grylloblattodea: grylloblattids, Phasmatodea: stick-insects, Orthoptera-Caerifera: locusts, Orthoptera-Ensifera: crickets, and Dermaptera: earwigs), were estimated based on DNA sequencing of the mitochondrial cytochrome oxidase II gene. Our results drew attention to the need for caution in using third codon positions for tree construction, since it was likely that base pair substitutions of third codon positions in the COII gene were saturated among taxa used in the present study. We also detected that there were many phylogenetically informative sites in first codon positions. Phylogenetic trees using first and second codon positions based on both the neighbor-joining method and parsimony analysis indicated that the topology was nearly identical to each other. The phylogenetic relationships among these taxa differ from the current classification based on morphological characters. The inferred trees showed that grylloblattids were not a primitive

group, but closely related to the Dictyoptera. Stick-insects were closely related to the Dictyoptera and grylloblattids, not to crickets. Locusts and crickets formed a monophyletic group. Earwigs were only distantly related to the Dictyoptera. Within the Dictyoptera, cockroaches and termites constituted a monophyletic group, with mantids as a sister group to that complex. [Phasmida work based on *Baculum irregulariterdentatum*, *Neohirasea japonica*, and *Trigonophasma rubescens*].

Sauer, A.E. & Stein, W. (1999) Sensorimotor pathways processing vibratory signals from the femoral chordotonal organ of the stick insect. *Journal of Comparative Physiology A Sensory Neural and Behavioral Physiology*, **185**(1): 21-31.

The femoral chordotonal organ of stick insects senses position and velocity of movements in the femur-tibia joint, as well as tibial vibration. While sensory information about large-scale tibial movements is processed by a well-known neuronal network and elicits resistance reflexes in extensor and flexor tibiae motoneurons, it is not yet known how sensory information about vibration of the tibia is processed. We investigated the transmission of vibration stimuli to tibial extensor motoneurons and their premotor interneurons. Vibration stimuli applied to the femoral chordotonal organ evoked responses in tibial extensor and flexor muscles. During ongoing vibration this response adapted rapidly. This adaptation had no effect on the motoneuronal response to large-scale tibial movements. Recording from premotor interneurons revealed that vibratory signals were processed in part by the same interneuronal pathways as (large-scale) velocity and position information. While only certain parts of the interneuronal reflex pathways showed little or no response during vibration stimuli, most neurons responded to both position or velocity stimuli and vibration at the femoral chordotonal organ. We conclude that sensory information about vibration of the tibia shares part of the interneuronal pathways that transmit sensory information about large-scale tibial movements to the motoneurons. [Phasmida used: *Cuniculina impigra*]

Seow-Choen, F. (1999) Stick and leaf insect (Phasmida: Insecta) biodiversity in the Nature Reserves of Singapore. *Gardens' Bulletin (Singapore)*, **49**(2): 297-312.

Forty-one species of phasmids found in Singapore extant as well as extinct are listed and aspects of their conservation discussed. Eleven species are still relatively common and are widely distributed especially within the Central Catchment Nature Reserve. Eleven species exist in only very isolated pockets within the Central Catchment Nature Reserve. One species has been found only in the Punggol area. A further ten species are very rare and in almost a decade of studying these insects only one or two specimens have been found in Singapore. An additional eight species have not been seen or recorded for at least 30 years and are best described as extinct in Singapore.

Stein, W. & Sauer, A.E. (1999) Physiology of vibration-sensitive afferents in the femoral chordotonal organ of the stick insect. *Journal of Comparative Physiology A Sensory Neural and Behavioral Physiology*, **184**(3): 253-263.

The femoral chordotonal organ in orthopterans signals proprioceptive sensory information concerning the femur-tibia joint to the central nervous system. In the stick insect, 80 out of 500 afferents sense tibial position, velocity, or acceleration. It has been assumed that the other sensory cells in the chordotonal organ would serve as vibration detectors. Extracellular recordings from the femoral chordotonal organ nerve in fact revealed a sensitivity of the sense organ for vibrations with frequencies ranging from 10 Hz to 4 kHz, with a maximum sensitivity between 200 and 800 Hz. Single vibration-sensitive afferents responded to the same range of frequencies. Their spike activity depended on acceleration

amplitude and displacement amplitude of the vibration stimulus. Additionally, 80% of the vibration-sensitive afferents received indirect presynaptic inputs from themselves or from other afferents of the femoral chordotonal organ, the amplitude of which depended on stimulus frequency and displacement amplitude. They were associated with a decrease of input resistance in the afferent terminal. From the present investigation we conclude that the femoral chordotonal organ of the stick insect is a bifunctional sensory organ that, on the one hand, measures position and movement of the tibia and, on the other hand, detects vibration of the tibia. [Work done on *Cuniculina impigra*].

Stein, W. & Schmitz, J. (1999) Multimodal convergence of presynaptic afferent inhibition in insect proprioceptors. *Journal of Neurophysiology (Bethesda)*, **82**(1): 512-514.

In the leg motor system of insects, several proprioceptive sense organs provide the CNS with information about posture and movement. Within one sensory organ, presynaptic inhibition shapes the inflow of sensory information to the CNS. We show here that also different proprioceptive sense organs can exert a presynaptic inhibition on each other. The afferents of one leg proprioceptor in the stick insect, either the position-sensitive femoral chordotonal organ or the load-sensitive campaniform sensilla, receive a primary afferent depolarization (PAD) from two other leg proprioceptors, the campaniform sensilla and/or the coxal hairplate. The reversal potential of this PAD is about -59 mV, and the PAD is associated with a conductance increase. The properties of this presynaptic input support the hypothesis that this PAD acts as presynaptic inhibition. The PAD reduces the amplitude of afferent action potentials and thus likely also afferent transmitter release and synaptic efficacy. These findings imply that PAD mechanisms of arthropod proprioceptors might be as complex as in vertebrates. [Work done on *Carausius morosus*].

Tilgner, E.H. & McHugh, J.V. (1999) First record of parasitism of *Manomera tenuescens* (Phasmida: Heteronemiidae) by *Phasmophaga antennalis* (Diptera: Tachinidae). *Entomological News*, **110**(3): 151-152.

The first case of parasitism of *Manomera tenuescens* by *Phasmophaga antennalis* is reported. This record represents the third known phasmid host for *P. antennalis* and the first known parasite for *M. tenuescens*.

Zompro, O. (1998) New phasmids from Neuguinea (Insecta: Phasmatodea). *Reichenbachia*, **32**(25-53): 157-163. [In German]

From the collections of the Staatliches Museum fuer Tierkunde, Dresden, Germany (SMTD) and the Museum d'Histoire Naturelle, Geneva, Switzerland (MHNG), four new species of the order Phasmatodea are described: *Leosthenes emmrichi*, *Phyllium groesseri*, *Breviphetes rubrus* and *Breviphetes viridis*. A new genus, *Breviphetes* gen. nov., is introduced for *Periphetes rammei* Günther, 1929, which is the type-species, and the two new species described here. The egg of *Heterocopus carli* Günther, which appears to be a member of *Pachymorpha* Gray, is described for the first time.

Erratum

A portion of the abstract on line nine of page 69 of *Phasmid Studies*, 7(2) was omitted. It should read:

"...*Datames* Stål, 1875 as a synonym of *Pylaemenes* Stål, 1875,.....